- REMARKS -

Claims 1 to 7 are in the application.

The application is in condition for allowance except for formal matters. Prosecution as to the merits is therefore closed.

The drawings are objected to for failing to show every feature of the invention as specified in the claims. As well, the drawings are objected to as system elements do not have a clear description in the specification by use of reference numerals.

The specification is objected to because of informalities: the fax machine did not print page 2 line 9 correctly.

Claim 3, 5 and 7 are objected to as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The drawings have been amended with numerals and the specification has been amended accordingly to overcome the Examiner's objection to the drawings.

The specification has been amended to add reference numbers and missing line. No new subject matter has been introduced as the paragraph corrected for the misprinted line reads the same as before.

Claim 3, 5 and 7 have been amended to overcome the Examiner's objections.

It is believed that claims 1-7 are allowable over the prior art, and a Notice of Allowance is earnestly solicited.

Respectfully submitted,
AHMED, Kamran

By:

James Anglehart (Reg. 38,796)

Encl. Marked-up copy of paragraph on page 2, line 7
Marked-up copy of paragraph on page 4, line 6
Marked-up copy of paragraph on page 7, line 1
Marked-up copy of paragraph on page 7, line 11
Marked-up copy of paragraph on page 7, line 23
Marked-up copy of paragraph on page 8, line 6
Marked-up copy of paragraph on page 8, line 10
Marked-up copy of paragraph on page 8, line 19
Marked-up copy of Claims 3, 5 and 7
Marked-up copy of Figs. 1, 2 and 3

MARKED-UP COPY OF PARAGRAPH ON PAGE 2, LINE 7

It is therefore a first object of the present invention to provide an apparatus and a method for controlling a single graphic controller system with a single memory subsystem having at least two display outputs, in which control of surface selection, conversion, combination, scaling and output is afforded without the limitations known in the prior art.

MARKED-UP COPY OF PARAGRAPH ON PAGE 4, LINE 6

The single controller system may alternatively comprises a drawing engine scaler instead of any one or all backend scalers responsive to a scaling command to pre-scale at least one surface in the graphics memory and output a scaled version in a scaled surface in the graphics memory; and one of the steps of causing the first display controller and causing the second display controller may comprise one of scaling the at least one of the first surfaces and the at least one of the second surfaces, respectively, using the drawing engine and reading the at least one of the first surfaces and the at least one of the second surfaces, respectively, from the scaled surface.

MARKED-UP COPY OF PARAGRAPH ON PAGE 7 AT LINE 1

Figure 1 shows a high level block diagram of the invention. Two CRTC controllers ~~(~~11~~,)~~ ~~and (~~12~~)~~ are capable of fetching 2 surfaces from memory ~~(~~50~~)~~ which can be SGRAM, SDRAM, or any other type of Random Access Memory. These surface can be in a variety of pixel formats including but not limited to RGB (8, 16, 24, 32) and YUV (4:2:0 , 4, 2, 2). The output of each CRTC 11, 12 can be displayed on a CRT monitor, TV or flat Panel displays 26, 28 via appropriate converters, encoders 30, 32 and transmitters. The Multiplexers ~~(~~33~~,) and (~~34~~)~~ allow routing of the output of each CRTC 11, 12 to either display 26, 28. This allows either display 26, 28 to receive the output from either CRTC 11, 12.

MARKED-UP COPY OF PARAGRAPH ON PAGE 7 AT LINE 11

Each CRTC contains one or more backend Scaler ~~(~~14~~)~~ (refer to Figure 2) that allows the input surfaces to be re-scaled before being combined (overlaid, blended etc.) with the other surface. Alternatively, prescaling of any surface could be done by the drawing engine 60~~-~~. A fixed or programmable color space converter ~~(~~15~~)~~ is included in one or both pixel data paths, so that combined pixels are in the same color space. For example, a surface can be in YCbCr format (video) and is converted in RGB (graphic) format before being combined with the RGB Windows desktop. Typically, but not exclusively, this is used to display a video surface (video in a window) under a graphic overlay surface (e.g. 2D desktop). Each CRTC 11, 12 also contains a combining unit 18 (or sub picture blending unit) for combining (overlaying or blending) the two surfaces. The output of the combining unit 18 is fed into a scaling unit 24 before being fed into a CRTC in RGB or YUV format.

MARKED-UP COPY OF PARAGRAPH ON PAGE 7 AT LINE 23

Typically, the graphics memory 50 and one or all encoders 30, 32 are external of the discrete device (ASIC) containing the CRTCs, the drawing engine 60 and the graphics subsystem manager 36.

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The operation and design of the blending units 18 and other units within the CRTCs ~~(~~Scaler 14, 16 and CSC 15~~)~~ are general and well known to someone skilled in the art and are therefore not described here.

MARKED-UP COPY OF PARAGRAPH ON PAGE 8 AT LINE 10

Instead of using the backend scaler 14, 16, the 3D drawing engine 60 of the graphics controller can also be used for pre-scaling surfaces and storing them in memory. While the scaling capabilities of the 3D drawing engine 60 are typically used for scaling textures for 3D objects, the capability can be leveraged to scale any type of surface by treating the surface as a texture. This also allows a CRTC 11, 12 having only one scaler to blend surfaces both of which need to be scaled, and this allows a CRTC 11, 12 having no scaler to blend surfaces in which at least one of the surfaces has been scaled prior to blending.

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It will be appreciated that CRTC1 11 and CRTC2 12 each read two surfaces from one memory 50, and that one or both of these surfaces may be the same surfaces in which case the same surface can be displayed in different ways. The present invention is also not limited to reading only two surfaces into two pixel paths, but a CRTC 11, 12 may be designed to be controlled to read three or more surfaces into three or more pixel paths.

MARKED-UP COPY OF THE CLAIMS

3. The method as claimed in claim 1, wherein:

said first display controller reads two first surfaces, has at least one controllable color space converters outputting a converted one of said two first surfaces in a selected one of RGB and YUV format video, and one scaling unit~~s~~ scaling an output of said ~~said~~ at least one color space converters and another scaling unit independently scaling another unconverted one of said two first surfaces ~~the unconverted surface~~, and a combining unit receiving an output of said two scaling units,

the method comprising causing said two scaling units to scale each of said two first surfaces.

5. The method as claimed in claim 1, wherein:

said second controller reads two second surfaces, has at least one controllable color space converters outputting a converted one of said two first surfaces in a selected one of RGB and YUV format video, and one scaling units scaling an output of said at least one color space converters and another scaling unit independently scaling another unconverted one of said two first surfaces ~~the un-converted surface~~, and a combining unit receiving an output of said two scaling units,

the method comprising causing said two scaling units to scale each of said two second surfaces.

7. The method as claimed in claim 1, wherein:

said single graphic controller system comprises a drawing engine scaler responsive to a scaling command to pre-scale at least one surface in said graphics memory and output a scaled version in a scaled surface in said graphics memory; and one of said steps of causing said first display controller and causing said second display controller comprises one of scaling said at least one of said first and second surfaces, respectively, using said drawing engine scaler and reading said at least one of said first and second surfaces, respectively, from said scaled surface wherein at least one of said first and second controllers does not have at least one scaling unit.~~of said backend scalers.~~

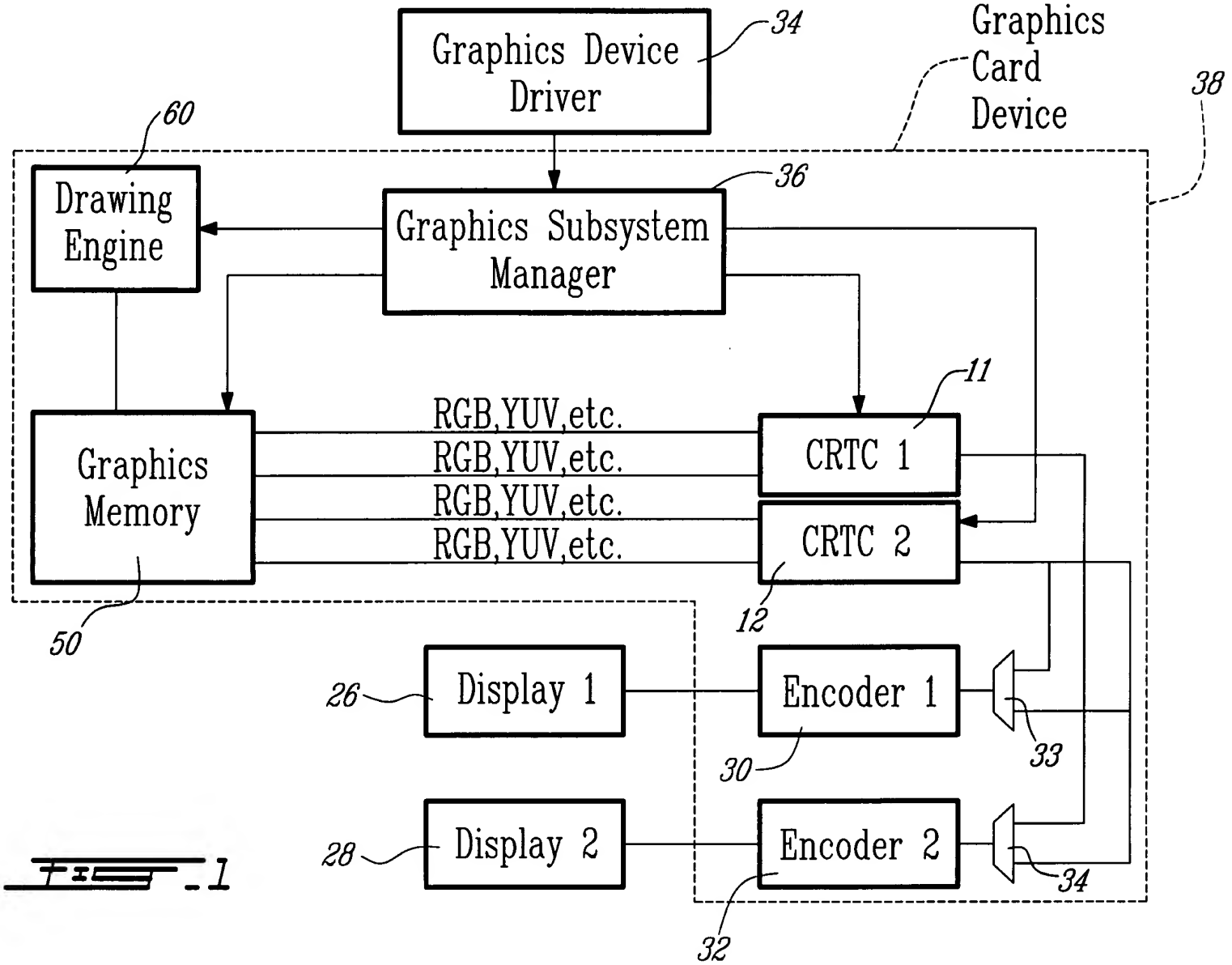
Graphics Device Driver
34
Graphics Card Device
38
60
Drawing Engine
36
Graphics Subsystem Manager
11
RGB,YUV,etc.
RGB,YUV,etc.
RGB,YUV,etc.
RGB,YUV,etc.
Graphics Memory
CRTC 1
CRTC 2
50
12
26
Display 1
Encoder 1
30
33
28
Display 2
Encoder 2
32
34

Fig. 1

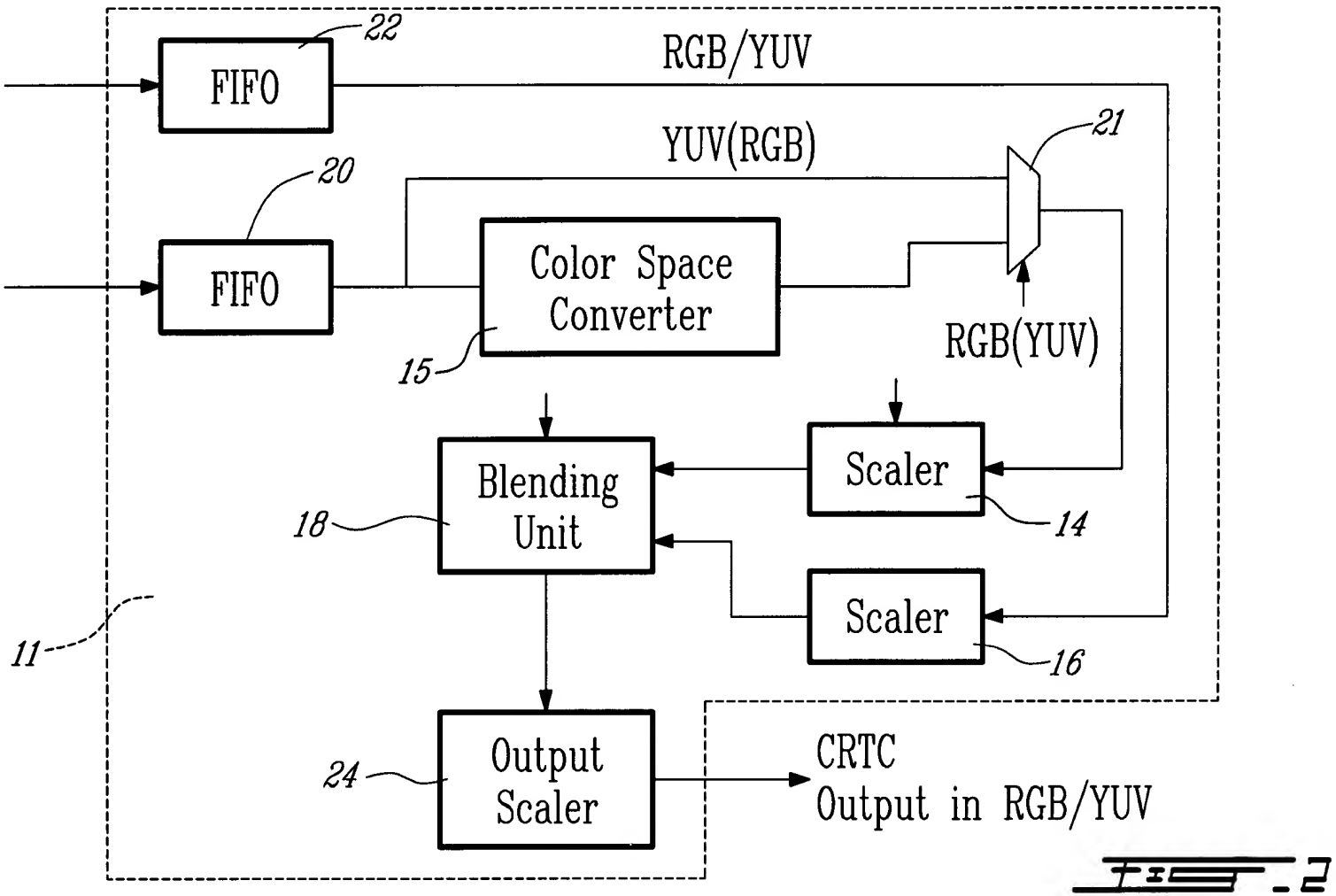
FIFO
22
RGB/YUV
YUV(RGB)
21
20
FIFO
Color Space
Converter
15
RGB(YUV)
Blending
Unit
18
Scaler
14
Scaler
16
11
Output
Scaler
24
CRTC
Output in RGB/YUV

Fig. 2

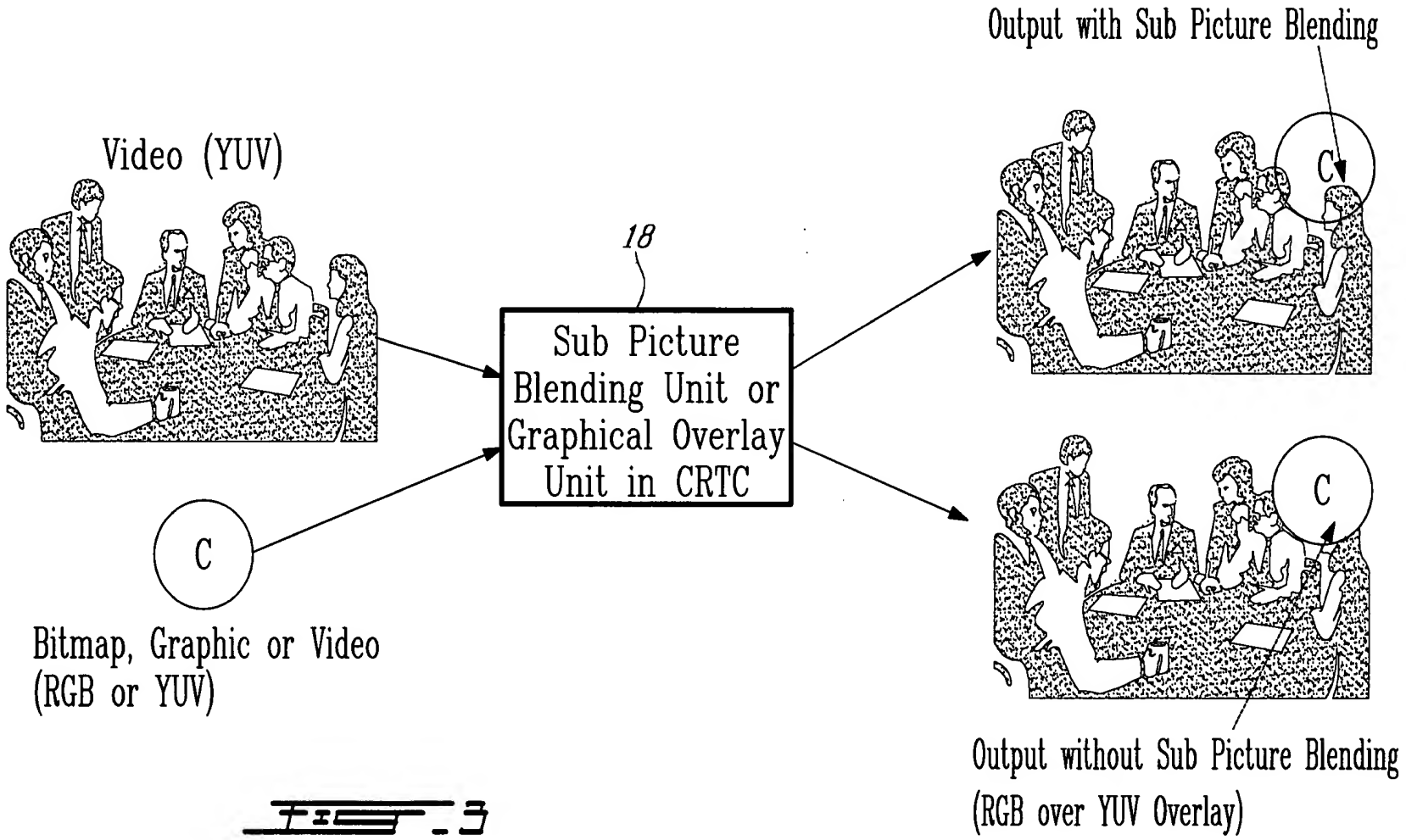
Output with Sub Picture Blending
Video (YUV)
18
Sub Picture Blending Unit or Graphical Overlay Unit in CRTC
C
C
C
Bitmap, Graphic or Video (RGB or YUV)
Output without Sub Picture Blending (RGB over YUV Overlay)

Fig. 3